LABOUR MARKETS AND MONETARY UNION: A STRATEGIC ANALYSIS*

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This paper shows that the effects of a monetary union depend on several labour market features. In particular, the switch from national monetary policies to a common monetary policy usually affects both inflation and unemployment, even when all structural parameters of the economy and of unions' and policymakers' preferences remain the same. The benchmark case of a monetary union between identical countries suggests that the switch to a monetary union is likely to make labour unions more aggressive, increasing unemployment. Qualifications to this result are provided under alternative institutional scenarios, like cross-country asymmetries, (pre-union) ERM membership and wage leadership.

This paper investigates the effects of the establishment of a monetary union on real wages, inflation and unemployment in the presence of unionised labour markets. Conventional wisdom, as embodied in the neutrality of money paradigm, would seem to suggest that the formation of a monetary union (MU) *per se* should not affect real variables. However, this point of view abstracts from changes in the strategic interaction between non-atomistic labour unions and the central bank brought about by the formation of a monetary union.

We show that in the presence of such interaction the formation of a MU may affect unemployment and inflation in the countries that form the union even when all the structural features of those countries, such as the level of central bank independence and the industrial organisation of labour markets, are unaltered by the establishment of a MU. The basic mechanism driving these results is that with the formation of the MU all unions become smaller relative to the monetary area (i.e. the monetary union reduces the wage share of each single union). This decreases their perception of the inflationary repercussions of their individual wages, inducing them to more aggressive wage demands.[1] In broader terms, our results relate to a recent strand of literature which shows that if wage setting is done by non-atomistic unions the natural rate of unemployment may depend on the structure of monetary institutions.

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[1] The essence of our formal argument has also been noticed in policy circles. In a recent report on wage setting and the EMU the Economic Policy Committee of the European Commission wrote: 'the change in the monetary regime with the move to EMU could potentially change the economic agents' behaviour. Before EMU those countries having a centralised/co-ordinated system of wage bargaining could have expected a ''national'' policy response following their wage agreements. Under EMU things might be different. The impact on inflation of one country would influence EUR11-wide inflation according to this country's weight in the EUR11 inflation rate. [...] Hence, the ''burden'' of the ECB's tighter monetary policy [...] would be externalised to an important extent (1998, p. 7)'.

The arguments developed here are based on the analytical framework developed in Cukierman and Lippi (1999), amended to allow for cross-country asymmetries in wage-setting structures. In this framework there are three key parameters that characterise the structure of labour markets: the centralisation of wage bargaining, the substitutability between the labour of different unions and, in line with several recent papers on the role of non-atomistic trade unions, the degree of unions' inflation aversion.[2] Monetary institutions are characterised by the degree of conservativeness of the central bank and by whether each country conducts a separate monetary policy or there is a unified monetary policy for all countries under consideration. More precisely, two alternative policy regimes are considered: (i) national monetary policies and (ii) monetary union.

The main results of the paper are derived by comparing the equilibria obtained under a MU with those obtained under national monetary policies (NMP). This is done by considering a two-stage strategic interaction between a central bank (CB) and a number of unions. In the first stage each union in each country sets its own nominal wage taking the nominal wages of other unions and the reaction-function of the CB as given. In the second stage, of the NMP regime, the CB in each country chooses inflation, so as to minimise the combined costs of inflation and of unemployment, taking unions' nominal wage rates as given. Under the MU regime, a single monetary authority chooses the area-wide inflation in the second stage and this is known by all unions in the first stage. The analysis focuses initially on the impacts of the formation of a MU in the benchmark case in which the parameters of all countries are identical. We then move on to study how these impacts vary with the relative sizes of member countries and with the relative degrees of centralisation of their labour markets.[3]

This paper is closely related to a recent paper by Grüner and Hefeker (1999). However, while they focus on the special case of a single union that encompasses the entire labour force, we develop the analysis for any number of labour unions within each country. The analysis reveals that there are substantial differences between the monopoly union case and the multi-union case, the most significant of which is that, in the presence of more than one union, the change in monetary regime leads to changes in real variables even if unions are not inflation averse. Soskice and Iversen (1998) also analyse the effects of the establishment of a MU on wage bargaining in the countries of the Euro area. Although the model they use is different from ours, the results of the two papers are broadly similar. One notable difference is that they consider the effects of a MU among identical economies each of which has a fully centralised wage-setting process, while we allow for cross-country differ-

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[2] The economic consequences of the inflation-averse unions assumption have been analysed by Agell and Ysander (1993), Cubitt (1992), Cukierman and Lippi (1999), Grüner and Hefeker (1999), Gylfason and Lindbeck (1994), Jensen (1997), Lippi (2000), Skott (1997) and Yashiv (1989).

[3] We deliberately abstract from open-economy spillovers in order to focus on the effects of a MU originating from changes in the strategic environment faced by unions. Further discussion of this issue appears in Section 6.1.

ences in the number of unions and in other structural parameters.[4] This allows us to study how the effects of the MU vary across the participating countries, depending on country size and on the degrees of centralisation of national labour markets.

The paper is organised as follows. Section 1 presents the basic analytical framework. Equilibria under a regime of NMP and in a two-country MU are presented, respectively, in Section 2 and 3. The impact of the formation of a MU on employment, real wages and inflation is discussed in Section 4. Section 5 analyses how the results vary under two alternative institutional assumptions: a unilateral exchange rate commitment (before entering the MU) and wage leadership by the unions of one country. A critical discussion of the normative implications of our analysis, with a special focus on the desirability and effects of reforming the conservatism of the common central bank, appears in Section 6. This is followed by concluding remarks.

1. Labour Markets and Monetary Policy: A Simple Model

We consider two countries named 1 and 2. The economy of country i ($i = 1, 2$) consists of n_i labour unions (indexed by $j = 1, 2, \ldots, n_i$) and of a CB. The objectives of the typical union j in country i are described by the loss function:

$$\Omega_{ij} \equiv -2w_{ij}^r + Au_{ij}^2 + B\pi_i^2, \qquad A, B > 0 \tag{1}$$

where w_{ij}^r and u_{ij} are, respectively, the (log of the) real wage and the unemployment rate among members of union j in country i, π_i is country i's inflation rate and A and B are preference parameters. The first two arguments reflect the union's sectorial interest and are conventional in the theory of trade unions' behaviour (e.g. Oswald, 1982), the third one reflects the union's aversion to inflation.[5] The CB dislikes both aggregate unemployment (u) and inflation, according to:

$$\Gamma_i \equiv u_i^2 + I\pi_i^2, \qquad I > 0 \tag{2}$$

where I is a measure of the CB aversion to inflation relatively to its aversion to unemployment and is commonly known, after Rogoff (1985a), as the degree of CB conservativeness.

Country's i labour supply is L_i. Labour is uniformly distributed over n_i unions and is supplied inelastically. The typical union (union j in country i) faces the labour demand:

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[4] Another difference is that in our model the reaction function of the central bank is derived explicitly from the objectives and constraints of the monetary authorities and is therefore endogenous. By contrast in Soskice and Iversen (1998) the monetary policy rule is exogenous (see their Mathematical Appendix, p. 123).

[5] This is at least partly due to the fact that the income, pensions and other wealth of union members are not fully indexed. Grüner and Hefeker (1999) report that the representatives of German labour unions recently demanded that inflation continue to be low in the newly formed European Monetary Union.

$$L_{ij}^d = \left[\frac{\alpha}{n_i}(d - w_{ij}^r) - \gamma_i(w_{ij}^r - \overline{w}_i^r)\right] L_i, \qquad \alpha, \gamma_i > 0 \tag{3}$$

where w_{ij}^r is the (log of the) real wage of union j members' and $\overline{w}_i^r \equiv \sum_{j=1}^{n_i} w_{ij}^r / n_i$ is a measure of country's i average real wage. The aggregate demand for labour in country i, L_i^d, is inversely related to the average real wage $\overline{w}_i^r$ $(L_i^d \equiv \sum_{j=1}^{n_i} L_{ij}^d = \alpha(d - \overline{w}_i^r) L_i)$. Equation (3) posits that when a union sets its real wage equal to the country average it obtains $1/n_i$ of aggregate labour demand. Since labour is differentiated, real wage deviations from the economy-wide average real wage induce a loss of labour demand which is proportional to γ_i, the degree of labour substitutability. Labour is only imperfectly substitutable if the parameter γ_i is finite. The unions' monopoly power is therefore decreasing in γ_i. Equation (3) also implies that the (absolute value of) real wage elasticity of labour demand facing union's j is increasing in the number of unions (n_i). As the number of unions goes towards infinity, unions completely loose their market power.[6] Thus, although *aggregate* labour demand is independent of the degree of wage bargaining decentralisation, unions have less monopoly power when the labour force is spread over a larger number of bargaining units, as suggested by Calmfors and Driffill (1988) and Calmfors (1993).[7] Countries may differ in labour force size (L_i), number of unions (n_i) and the degree of labour substitutability (γ_i).

The specification of labour demand in (3) postulates that labour substitutability is confined to national borders. This is done both for tractability as well as because it is reasonable to presume that labour mobility within a country is higher than its mobility across countries. Moreover, labour demand is assumed to be invariant to the monetary policy regime. The latter reflects our presumption that, at least to a first approximation, the formation of a MU does not alter the degree of competition in the labour market.[8]

We use the word 'area' to denote the geographical union of country 1 and 2. The aggregate unemployment rate in the area is:

$$u = \frac{L_1 + L_2 - (L_1^d + L_2^d)}{L_1 + L_2} = s_1 u_1 + s_2 u_2 \tag{4}$$

where $s_i \equiv L_i/(L_1 + L_2)$ is a relative country size measure and $u_i \equiv (L_i - L_i^d)/L_i$ is country i unemployment rate.[9]

It is useful to define the real wage premium over the market clearing real wage: $\phi_{ij} \equiv w_{ij}^r - w^{rc}$ where $w^{rc} \equiv d - 1/\alpha$ is the real wage at which $u = 0$ (at

[6] The real wage elasticity is $\eta_j = [\alpha + \gamma(n-1)]/[\alpha(d - w_j^r) - n\gamma(w_j^r - \overline{w}^r)]$, which is increasing in n at a symmetric equilibrium (where wages are identical across unions).

[7] The assumption that the degree of labour market competition increases with the number of unions is not a necessary ingredient of our story. Market power and unions' atomism can be treated independently: this is done in Lippi (1999) where it is shown that unions may have market power and yet no real effects of monetary policy arise with atomistic unions.

[8] Competition might increase in the MU if labour substitutability increases owing to higher labour or capital mobility in the MU. This view is stressed, among others, by Burda (1999).

[9] Obviously $s_2 = 1 - s_1$ in our two-country model. The model, however, can be easily extended to more than 2 countries.

the country level: $\bar{\phi}_i \equiv \bar{w}_i^r - w^{rc}$; at the area-level $\bar{\phi} \equiv s_1\bar{\phi}_1 + s_2\bar{\phi}_2$). The market clearing real wage is the same in the two countries, as the structural parameters that determine it are, for simplicity, assumed to be identical. Using the real wage definition, $w_{ij}^r \equiv w_{ij} - \pi_i$ (where w_{ij} indicates the logarithm of the nominal wage of union j in country i[10]), the area-wide unemployment rate can be rewritten as:

$$u = \alpha(\bar{w} - \pi - w^{rc}) = \alpha\bar{\phi} \tag{5}$$

where $\bar{w} \equiv s_1\bar{w}_1 + s_2\bar{w}_2$ is the area-wide nominal wage and $\bar{w}_i \equiv \sum_{j=1}^{n_i} w_{ij}/n_i$ is country's i average nominal wage.

2. The Case of National Monetary Policy

We begin by considering the equilibrium under national monetary policy (NMP), i.e. a setup where each country has its own central bank setting the inflation rate.[11] A two-stage game is considered and solved by backward induction, focusing on discretionary monetary policy. In the second stage, the CB chooses inflation to minimise (2) taking the nominal wages previously set by all unions as given. This yields the reaction function:[12]

$$\pi_i = \frac{\alpha^2}{\alpha^2 + I}(\bar{w}_i - w^{rc}). \tag{6}$$

In the first stage unions choose their nominal wages simultaneously. Union j in country i chooses its nominal wage, w_{ij}, to minimise (1), taking the nominal wages of other unions and the reaction function of monetary policy to nominal wages (6) as given. This yields the equilibrium real wage premium (outcomes under NMP are denoted by the superscript N):[13]

$$\bar{\phi}_i^N = \frac{Z_i^N}{\alpha\left\{(1 - Z_i^N)B\dfrac{\alpha}{I} + A\left[\alpha Z_i^N + \gamma_i(n_i - 1)\right]\right\}} = \phi_{ij}^N, \tag{7}$$

where $Z_i^N \equiv 1 - \dfrac{d\pi_i}{dw_{ij}} = 1 - \dfrac{\alpha^2}{(\alpha^2 + I)n_i}$, $j = 1 \dots n_i; i = 1, 2.$ (8)

Since we focus on a symmetric equilibrium, the wage premium is identical across unions. Note that the premium is larger than zero if unions have some

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[10] To simplify notation, and without loss of generality, the (log of the) previous-period's price level, p_{-1}, is normalised to zero so that $\pi = p - p_{-1} = p$. The results in Cukierman and Lippi (2000), where the previous period's price level is not normalised to zero, are identical to those presented here.

[11] The results for this case are analogous to those in Cukierman and Lippi (1999), where a full discussion of the features of equilibrium outcomes under the NMP regime (Section 4) and some empirical evidence (Section 5) are provided. They are therefore presented here in a compact way.

[12] The central bank of country i sets the inflation rate (π_i) to minimise (2) taking $\bar{w}_i$ as given, subject to the unemployment (4) with $s_i = 1$.

[13] Each union minimises (1) with respect to w_{ij} subject to (6) and $u_{ij} \equiv (L_{ij} - L_{ij}^d)/L_{ij} = \alpha(w_{ij} - \pi_i - w^{rc}) + \gamma n_i(w_{ij} - \bar{w}_i)$. Summing over all unions' first order conditions and rearranging terms yields (7).

degree of monopoly power (i.e. when both n_i and γ_i are finite). Note also that, other things being equal, the wage premium is an increasing function of Z_i^N, a variable that measures the effectiveness of changes in the nominal wage in bringing about changes in the real wage under NMP. The expression for Z_i^N shows that the effectiveness is lower the smaller the number of unions and the less averse to inflation is the CB.

In a rational expectations equilibrium ($E\pi_i = \pi_i$) unemployment and inflation under NMP are given by:

$$u_i^N = \alpha \bar{\phi}_i^N \quad \text{and} \quad \pi_i^N = (\alpha^2/I)\bar{\phi}_i^N. \tag{9}$$

Since the equilibrium average wage premium is positive, both unemployment and inflation are larger than zero. The former is due to the unions' monopoly power, which enables them to raise the real wage of employed members above the competitive level.[14] The latter is due to the policymaker's incentives under discretionary policy as in Kydland and Prescott (1997) and Barro-Gordon (1983). But, since in the current model unemployment is due to union power rather than to distortionary taxes, the inflationary bias vanishes when this power, and therefore unemployment, becomes negligible. It also appears that, for a given wage premium, inflation decreases as the central bank conservativeness (I) increases.

A key feature of equilibrium outcomes is that the level of central bank conservativeness affects *unemployment* provided unions are non-atomistic (we label this effect 'strategic non-neutrality' since it is due to the strategic interaction between the unions and the CB). This mechanism is also crucial for the understanding of the workings of the MU described in the next section.

PROPOSITION 1. *An increase in the degree of central bank conservativeness raises the rate of unemployment if unions are non-atomistic ($n < \infty$) and at least one of the following conditions holds:*

(i) unions are averse to inflation ($B > 0$)
(ii) there are at least two unions and some degree of substitutability in the demand for their labour ($n \geqslant 2$ and $\gamma > 0$).

As unions become atomistic ($n \to \infty$) the unemployment effect vanishes.

The two conditions in the proposition correspond to two different kinds of strategic non-neutralities.[15] The first operates through trade unions' concern about inflation ($B > 0$). When unions dislike inflation, their wage demands are moderated by the inflation consequences of a higher wage premium (see

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[14] Since the unions' monopoly power vanishes when the labour market is completely decentralised inflation (unemployment) is equal to zero if $n \to \infty$. This need not necessarily be the case in a model where atomistic agents retain some monopoly power over their sales, as in the monopolisitc competition framework of Dixit and Stiglitz (1977). Lippi (1999) develops a monetary model based on that framework.

[15] This can be seen from the first order derivative of (7) with respect to I (see equation 17 in Cukierman and Lippi, 1999).

(7). Crucially, the intensity of this moderating effect is weaker when the central bank is more inflation averse (higher I), since less inflation is associated with any given wage increase. Hence a more conservative central bank induces unions to demand higher real wages. In the limit, as the number of unions becomes very large, their monopoly power disappears and both inflation and unemployment are zero.[16]

Provided there is more than one union in the economy, there is a second source of strategic non-neutrality which operates even when unions are not concerned with price stability ($B = 0$). It is due to the fact that under nominal wage contracting, to obtain a unit increase in its real wage rate, a single union needs to accept a *higher* increase in its *relative* wage, the *smaller* is I.[17] To illustrate, a less inflation-averse central bank leads unions to perceive a given increase in their own real wage as more costly in terms of competitiveness (relative wage), moderating the unions' real wage demands.[18] We refer to this as the 'adverse competitiveness' effect. Neutrality reappears when n is large, even when conditions *i* and *ii* hold, since in this case each union neglects the effect of its own actions on inflation (as can be seen from (8)).

3. The Monetary Union

This section derives outcomes under the institutional setting of a monetary union (MU). To focus on the *net* effect a MU it is assumed that the establishment of the MU does not change any of the structural parameters of the underlying economies. Importantly, it is assumed that the formation of a MU, *per se*, does not alter the degree of labour mobility across the countries in the MU so that labour substitutability continues to operate within, but not between, countries. Besides being methodologically convenient such a presumption seems realistic, at least for the short and intermediate run. Moreover, it is assumed that all unions set wages simultaneously, i.e. no union (or country) is a leader in wage setting (the consequences of partial relaxation of these assumptions are studied in Sections 5.2 and 6.2).

It would seem at first blush that, under the above conditions, the shift to a MU should not affect real variables. This at least is the implication of a standard Barro-Gordon framework in which unions' choices are not modelled explicitly. As we shall see, however, the result is different if account is taken of trade unions' incentives.

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[16] The number of unions has an independent direct effect on the size of the wage premium, which is discussed at length in Proposition 2 of Cukierman and Lippi (1999), where it is shown that the relation between the wage premium and the number of unions may be either hump shaped or decreasing in n_i, depending on parameter values.

[17] Technically, this occurs because the marginal impact of a unit increase in a union's nominal wage rate on its real wage depends (positively) on I whereas its impact on the relative wage does not.

[18] This second non-neutrality contrasts with most of the literature on monetary policy games under perfect information in which (when unions are indifferent to inflation) the CB 'conservatism' (i.e. the parameter I) affects inflation but does not affect real variables. Lippi (1999) shows that an analogous result emerges from a traditional Dixit and Stiglitz (1977) model of monopolistic competition with non-atomistic private agents.

The loss function of the single central bank in the MU (superscript U) is given by (2) where the inflation and unemployment arguments are now area-wide measures. The monetary policy authority's reaction function, which in terms of area-wide variables is identical to (6), can be rewritten as:

$$\pi^U = \frac{\alpha^2}{\alpha^2 + I}(s_1 \bar{w}_1^U + s_2 \bar{w}_2^U - w^{rc}). \tag{10}$$

Union j in country i minimises the loss function (1) subject to (3) and to (10), taking the nominal wages of the other unions, both at home and abroad, as given (see footnote 13). Manipulations of a typical Country 2 union's first order condition allows the average wage premium in Country 2 to be written in terms of the average wage premium in Country 1 as:

$$\bar{\phi}_2^U = \frac{Z_2^U - (B\alpha^2/I)(1 - Z_2^U)s_1\bar{\phi}_1^U}{\alpha A[\alpha Z_2^U + \gamma_2(n_2 - 1)] + (B\alpha^2/I)(1 - Z_2^U)s_2} \tag{11}$$

where $Z_i^U \equiv 1 - \dfrac{d\pi^U}{dw_{ij}} = 1 - \dfrac{\alpha^2}{(\alpha^2 + I)}\dfrac{s_i}{n_i}, \qquad j = 1, \ldots, n_i, \ i = 1, 2.$ (12)

Since we are assuming that unions move simultaneously in all countries an expression analogous to (11) holds for the average wage premium of Country 1 in terms of the average wage premium of Country 2. Moreover, given that within each country unions are identical in size, we focus on a symmetric equilibrium where the premium requested by each individual union within a given country is the same.

It appears from (11) that trade unions' concern about inflation ($B > 0$) *creates* interdependencies between the real wages of the member countries. These cross effects are obviously absent under a regime of national monetary policies. Since the average wage premium of Country 1 influences the single monetary policy and therefore the area-wide inflation rate, unions in Country 2 take this into account when setting wages. In particular, wage premia turn out to be *strategic substitutes* since a higher average wage premium in one country raises the area-wide inflation and therefore induces unions in the other country to moderate their wage demands.[19]

In general, the intensity of the reaction of 'domestic' wages to 'foreign' wages depends on a number of country-specific features. Analysis of the partial derivative $\partial \bar{\phi}_2^U / \partial \bar{\phi}_1^U$ delivers the following:

PROPOSITION 2. *The reaction of the wage premium in Country 2 ('domestic') to the premium in Country 1 ('foreign') is almost nil if:*

    (*i*) *unions in the domestic country are atomistic* ($n_2 \to \infty$)

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[19] When $B = 0$ there is no link between the real wages of unions across different countries, but there is a link between the *nominal* wages of the two countries under MU (this is demonstrated in Subsection 5.2). Intuitively, this occurs because higher nominal wages in one country tend to increase the area-wide inflation. Therefore, unions in the other country increase their nominal wages in order to maintain their (individually optimal) equilibrium real wage.

    (ii) the domestic country is very small ($s_2 \sim 0$)
    (iii) the inflation aversion of the central bank is very high ($I \to \infty$)
    (iv) the foreign country is very small ($s_1 \sim 0$)
    (v) unions do not care about inflation ($B \sim 0$)

    Intuitively, in the first three cases there is no reaction to the foreign premium since each union in Country 2 perceives that it has no impact on inflation (hence $Z = 1$), even though this is due to different reasons in each case. Under case (*iv*) the foreign premium does not influence the domestic one since it is nearly irrelevant to the determination of MU-wide inflation.

    The equilibrium wage premia $\bar{\phi}_1^U$ and $\bar{\phi}_2^U$ are given by the point where the reaction functions (equation (11) and its counterpart for Country 1 unions) cross in the ($\bar{\phi}_1^U$, $\bar{\phi}_2^U$) space. The equilibrium wage premium in Country 1 is given by the following expression (an equivalent expression holds for Country 2):

$$\bar{\phi}_1^U = \frac{Z_1^U H_2^U + (B\alpha^2/I)(Z_1^U - Z_2^U)s_2}{H_1^U\left[H_2^U + (B\alpha^2/I)(1 - Z_2^U)s_2\right] + (B\alpha^2/I)(1 - Z_1^U)H_2^U s_1}$$

$$= \phi_{1j}^U \qquad j = 1, \ldots, n_1. \tag{13}$$

$$\text{where } H_i^U \equiv \alpha A[\alpha Z_i^U + \gamma_i(n_i - 1)] \qquad i = 1,2.$$

    Simple algebra reveals that expression (13) reduces to (7) when $s_1 = 1$ (hence $s_2 = 0$) which is the case of a national monetary policy by Country 1. It also appears from this expression that, as unions in country i become atomistic (i.e. $n_i \to \infty$), the wage premia converge to zero irrespective of the monetary regime and of country size. Thus, the independence between the *real* economy and the monetary regime is obtained as a special case in our model when the labour unions are atomistic.

4. The Effects of a Monetary Union: Some Specific Cases

Equations (11) and (13) show that the establishment of a MU induces complex interactions between wages in the two countries. Those interactions depend on the number of unions, country size, union preferences, labour substitutability in each country and the level of CB conservativeness. In general, the outcomes of the model vary depending on the nature of structural differences between the countries forming the monetary union. To develop some understanding of how those differences influence the effect of a monetary union we start from a simple benchmark case, in which all countries have identical parameters. We then proceed gradually to more complex cases.

    Our aim is to analyse the *direct* effect of the MU on unions' behaviour, i.e. to study the impact of the MU in comparison to outcomes obtained under the NMP regime. This effect is 'direct' in that it is based on the assumption that all relevant parameters are unaltered by the formation of the MU. Formally, the direct effect of the formation of a MU on the real wages in country i is defined

as $\bar{\phi}_i^U - \bar{\phi}_i^N$ for *unchanged* underlying parameters. Note that once this effect is known it is possible to determine the effects of the MU on the rates of unemployment and inflation in the two countries by comparing the expressions for unemployment and inflation under NMP (9) with their counterparts under MU, which are given by:

$$u_i^U = \alpha\bar{\phi}_i^U, \quad \text{and} \quad \pi^U = \frac{\alpha^2}{I}(s_1\bar{\phi}_1^U + s_2\bar{\phi}_2^U) = \frac{\alpha^2}{I}\bar{\phi}^U. \tag{14}$$

We start by analysing the direct effect of a MU between two countries that are identical in every respect. We then study the direct effect of the MU under the assumption that unions are not inflation averse ($B = 0$). The latter case is of interest because it relates the results of our model to the numerous studies in which unions are assumed not to care about inflation. For this case we also analyse how the direct effects of the MU vary with country size, the number of unions in each country and the degree of competition in the labour market in each country.[20]

4.1. *A Monetary Union Between Identical Countries*

It is useful to begin the analysis from the case of a MU between countries that are identical in their labour forces ($s_1 = s_2 = 1/2$), number of unions ($n_1 = n_2 = n$) and degree of substitutability between labour ($\gamma_1 = \gamma_2 = \gamma$). In this case the premium demanded by unions in the MU is obtained by substituting the parametric values given above into (13), yielding:[21]

$$\bar{\phi}_i^U = \frac{Z_i^U}{H_i^U + (B\alpha^2/I)(1 - Z_i^U)} = \phi_{ij}^U \qquad i = 1, 2; j = 1, \ldots, n_i. \tag{16}$$

To compare the value of the wage premium given by (16) with the value obtained under the NMP regime (7) the latter can be conveniently rewritten as:

$$\bar{\phi}_i^N = \frac{Z_i^N}{H_i^N + (B\alpha^2/I)(1 - Z_i^N)} = \phi_{ij}^N \qquad i = 1, 2; j = 1, \ldots, n_i \tag{17}$$

(where H_i^N and Z_i^N are the NMP counterparts of H^U and of Z^U with $s_i = 1$). Comparison of (16) with (17) for identical values of n and γ immediately leads to:

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[20] In a previous version of the paper we also studied the direct effect of a union when the degree of labour substitutability (γ) differs across countries (see Section 4.2 in Cukierman and Lippi, 2000). This exercise shows that the MU increases unemployment in the country in which the labour market is less substitutable and may even decrease unemployment in the other country.

[21] Since for this case $Z_1^U = Z_2^U \equiv Z^U$ and $H_1^U = H_2^U \equiv H^U$, the wage premium under MU is the same across all unions in both countries and is given, in terms of basic parameters, by:

$$\bar{\phi}_i^U = \frac{I\left[(n - \frac{1}{2})\alpha^2 + nI\right]}{\alpha\left(\frac{B\alpha^3}{2} + AI\{\alpha[(n - \frac{1}{2})\alpha^2 + nI] + \gamma(n-1)n(\alpha^2 + I)\}\right)} \qquad i = 1, 2. \tag{15}$$

PROPOSITION 3. *If union and central-bank preferences are identical across countries and do not change with the establishment of the MU, then the wage premium in the MU is higher than the one obtained under NMP at all levels of n.*

Intuitively, the switch from the NMP to the MU regime reduces the extent to which each union internalises the inflationary repercussions of its own actions, thus raising Z (i.e. $Z^U > Z^N$). This alters union behaviour via two separate channels. The first operates through unions' inflation concern ($B > 0$) and the second through a mitigation of the adverse competitive effect of an increase in inflation (when $\gamma > 0$ and $n > 1$). Hence the formation of a MU leads to less moderation in unions' real wage demands through both channels. The upshot is that, if union are not atomistic ($n < \infty$), the switch from NMP to MU increases the wage premium. Given (14), this means that both inflation and unemployment (in every country) are increased by the establishment of a MU.

4.2. *A MU Between Heterogeneous Countries When Unions Do Not Care About Inflation*

We now consider the direct effect of a MU in the case in which unions are not inflation averse and study how the direct effect of the establishment of a MU varies with country size (s_i), labour substitutability (γ_i) and the number of unions (n_i). When $B = 0$ the general expression for the wage premia of a country in the MU (13) reduces to:

$$\bar{\phi}_i^U = \frac{Z_i^U}{H_i^U} = \left\{ \alpha^2 A + \alpha A \frac{\gamma_i(n_i - 1)}{[1 - \alpha^2/(\alpha^2 + I)](s_i/n_i)} \right\}^{-1} = \phi_{ij}$$

$$i = 1, 2; \quad j = 1, \ldots, n_i \tag{18}$$

Comparison of the wage premium under MU with the corresponding premium under NMP leads to the following proposition (the proof is in the Appendix):

PROPOSITION 4. *If unions do not care about price stability ($B = 0$), there is a finite number of unions ($1 < n_i < \infty$) and some competitiveness between them ($\gamma_i > 0$) then the direct effect of a MU on the wage premium is:*

(*i*)   *positive in all countries,*
(*ii*) *greater in smaller countries,*
(*iii*) *greater in countries characterised by intermediate levels of centralisation of wage bargaining (n_i) and labour market competitiveness (γ_i).*

The first result states that, in the absence of inflation aversion on the part of unions and provided there is more than one union in the economy, the formation of a MU unambiguously increases real wages (and hence inflation and unemployment). This effect is triggered by the *decrease* in the moderating influence that the adverse competitive effect has on unions' wage demands (see Proposition 1). Basically, in a MU each labour union internalises the

inflationary impact of its individual actions, and of the associated deterioration in competitiveness, to a lesser extent. This induces each union to adopt a more aggressive wage strategy, which, in equilibrium, results in higher real wage premia in *all* countries.

The proposition also shows that the impact of a MU varies with some structural features of the country that joins the union. The direct effect of joining a MU on a country's real wage increases as the size, s_i, of the country in the MU decreases. The intuition is that the smaller a country is, in relation to the whole union, the larger will be the relative change in size that its labour unions experience as a result of membership in the MU.[22] Since unions in a smaller country internalise the repercussions of their actions on the MU rate of inflation to a lesser extent, their wage-setting strategy becomes more aggressive to a greater extent than that of larger countries.

Finally, the proposition states that the effect of the MU is largest at intermediate levels of centralisation and of labour market competition (as measured by the labour substitutability parameter, γ_i). The reason is that when either n_i or γ_i is large, labour market performance converges towards the competitive, market-clearing level, irrespective of the monetary regime. At the other extreme, when $n_i = 1$ or $\gamma_i = 0$ the degree of competition in the labour market is zero; therefore the monetary regime does not affect the wage premium because the *adverse competitive effect* does not operate. Hence, the largest direct effect of the MU occurs in countries with intermediate levels of centralisation of wage bargaining and of labour substitutability.

5. Alternative Institutional Scenarios

This section examines the sensitivity of the results to variations in some of our institutional assumptions, bringing the analysis one step closer to the European situation. First, we consider the hypothesis that before joining the MU some European countries had already subjugated their monetary policies to that of Germany through the Exchange Rate Mechanism (ERM). Second, we modify the simultaneous wage setting scheme allowing for wage-leadership by the unions of a given country (i.e. we solve a Stackelberg game).[23]

5.1. *The Direct Effect of Switching from a (Credible) ERM to the MU*

We model the ERM regime as an asymmetric mechanism where the central bank of Germany (the anchor country) conducts its monetary policy indepen-

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[22] Each union is concerned with the relative size of its nominal wages with respect to the aggregate nominal wage to which the central bank responds (6). The formation of the MU affects the latter variable.

[23] Related exercises are developed by Grüner and Hefeker (1999) and Soskice and Iversen (1998). As discussed in the introduction, one difference in comparison to their models is that we abandon the assumption of a single monopoly union and of identical countries.

dently, focusing only on domestic conditions, while the central banks of the other countries precommit to follow the German inflation rate. Therefore, by characterising membership in the ERM as a 'direct' precommitment to German inflation it is implicitly assumed that the ERM exchange rate commitment is credible.[24]

Under this characterisation of the monetary regime, monetary policy in Germany in the pre-MU period is described by the NMP regime so that the equilibrium wage premium is given by (7). The crucial difference introduced by the existence of a credible ERM in the pre-MU period concerns the unions of the countries that precommitted to follow German monetary policy. For these unions domestic inflation is unrelated to their wage premia, because they know that domestic inflation is determined by the German CB, which looks *only* at developments in Germany. This implies that each union in the 'other' ERM countries (subscript 'other') perceives that its individual actions have no impact on the rate of inflation (i.e. that $\partial \pi / \partial w_{j,other} = 0$ implying $Z_{other} = 1$). Hence the wage premium in the 'other' countries under the ERM is:

$$\bar{\phi}_{other}^{ERM} = \frac{1}{\alpha A[\alpha + \gamma(n-1)]} \tag{19}$$

which is larger than the premium obtained under NMP.[25] The fact that under a credible ERM the unions in the 'other' countries do not internalise the impact of their actions on inflation eliminates a deterrent to high wage claims and therefore leads unions to adopt a more aggressive wage strategy.

Under this characterisation, the creation of a MU should increase the wage premium of German unions and decrease the premia of unions in 'other' countries. The reason is that the creation of a MU *reduces* the perceived impact of each individual German union on inflation whereas the opposite happens in the 'other' countries, whose unions now correctly realise that their wage decisions have a non-zero impact on the inflationary reaction of the monetary union's CB. Soskice and Iversen (1998), who consider a similar characterisation of the ERM, suggest that this prediction is 'clearly borne out empirically in the period from 1983 to 1992 (p. 120)'. Note, however, that the expression for the wage premium suggests that one should also control for cross-country differences in the degree of centralisation, labour substitutability and unions' preferences. For instance, if the labour market structure in one of the 'other' countries is highly decentralised (high n) or highly competitive because of high labour substitutability (high γ), or both, the unemployment rate in that country may be lower than in the anchor country.

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[24] Several European countries attempted to reduce inflation towards the lower German rates by stipulating some form of exchange-rate precommitment with Germany, of which the ERM is a paramount example. Obviously, a precise formalisation of the ERM would require a model with foreign trade and exchange rates.

[25] This follows from the observation that the wage premium is increasing in Z (see (7)).

5.2. *The Effects of Wage Leadership by a Country in the MU*

In some European countries wage setting in the recent past was characterised by wage leadership on the part of a major union. In Germany, for instance, the metalworkers' union (IG Metall) played a leadership role *vis à vis* the other unions. Soskice and Iversen (1998) report that between 1974 and 1994 IGM set the norm for wage increases in 15 out of 21 bargaining rounds. A full analysis of wage leadership would require incorporating the possibility that there are, within *each* country, *both* leaders and followers. For reason of brevity we present a less ambitious analysis in which all unions in one country are Stackelberg leaders in wage setting and all unions of the other country are Stackelberg followers. Although less general, this specification makes it possible to capitalise on some of the earlier results and still obtain insights into some of the differences in macro outcomes between a MU in which all unions move simultaneously and a MU in which some act as wage leaders. It may also be of independent interest to the extent that the unions of a large country, such as Germany, develop a wage leadership position in the future.

To differentiate between leaders and followers we extend the timing structure to three stages. In the first stage the unions of Country 1 that are the wage leaders set their nominal wages. The negotiated wages are observed and taken as given by the unions of Country 2 when they set their nominal wages in the second stage. In the third stage, after observing the negotiated area-wide wages, monetary policy is chosen by the central bank of the MU. The game is solved by backward induction. In the second stage, the unions of Country 2 set their nominal wages taking as given the nominal wages of unions in Country 1 and knowing the CB reaction function (10). This leads to the following reaction function of the average *nominal* wages in Country 2 to Country 1 wages:

$$\bar{w}_2 = \Theta_1 + \Theta_2 \bar{w}_1 \qquad (20)$$

$$\text{where} \quad \begin{cases} \Theta_1 \equiv \dfrac{w^{rc}\left[H_2^U(1-\theta) + B(1-Z_2^U)\right] + Z_2^U}{(1-\theta s_2)H_2^U + B(1-Z_2^U)\theta s_2} \\[4mm] \Theta_2 \equiv \dfrac{\theta s_1\left[H_2^U - B(1-Z_2^U)\right]}{(1-\theta s_2)H_2^U + B(1-Z_2^U)\theta s_2} < 1 \\[4mm] \theta \equiv \dfrac{\alpha^2}{\alpha^2 + I}. \end{cases}$$

Equation (20) is obtained from the first order condition of a typical union in Country 2, after aggregating over all unions. This reaction function is the *nominal* wage counterpart of the reaction function between the real wage premia (equation 11) presented in Section 3.[26] Despite its cumbersome

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[26] If expressed in real terms, expression (20) yields (11). Obviously, this is true only for the unions of Country 2, which take Country 1 wages as given both under simultaneous bargaining and under Country 1 wage leadership.

algebraic form, (20) has a simple interpretation. The slope coefficient Θ_2 shows how nominal wages in Country 2 react to increases in the nominal wages of Country 1. Even in the simple case in which unions do not care about inflation ($B = 0$), it appears that nominal wages are linked, since if unions in Country 1 increase their wages, inflation will increase, and so unions in Country 2 scale up their wages accordingly in order to maintain the real value of their wages.[27] More generally, when B is not zero, the sign of Θ_2 depends on the size of B. This is summarised in the following:

REMARK 1. *If* $B \geqslant B_T \equiv H_2^U/(1 - Z_2^U)$ *then* $\partial \bar{w}_2/\partial \bar{w}_1 \equiv \Theta_2 \leqslant 0$; *otherwise* $\partial \bar{w}_2/\partial \bar{w}_1 \equiv \Theta_2 > 0$.

The dependence on B of the sign of the response of country's 2 nominal wages to an increase in country's 1 nominal wages is due to the fact that this increase triggers two opposite effects on nominal wages in Country 2. On one hand, owing to their inflation aversion, country 2 unions are willing to take a cut in real wages in order to moderate the inflationary response of the CB to the increase in the nominal wages of Country 1. On the other hand, they also wish to protect their real wages in the face of the higher subsequent inflation triggered by the response of the CB to the increase in Country's 1 nominal wages. If unions' inflation aversion is sufficiently high ($B \geqslant B_T$) the first effect dominates, and an increase in Country's 1 nominal wages leads unions in Country 2 to reduce their nominal wages in order to avoid excessive inflation by the CB of the MU. When unions' inflation aversion is not sufficiently high ($B < B_T$), the desire to avoid an excessive reduction in the real wage dominates, and nominal wages in Country 2 go up. But the increase in the nominal wage in this case is *less* than proportional ($\Theta_2 < 1$).[28]

In the first stage of the game the leading unions of Country 1 set nominal wages taking account of the reaction of nominal wages in Country 2 and of the monetary policy reaction function ((20) and (10), respectively). The first order condition of the typical union problem in Country 1 implies the following reaction function of the average wage premium in Country 1 to the average wage premium in Country 2 (the superscript 'L' denotes a regime with leader and follower unions):

$$\bar{\phi}_1^L = \frac{Z_1^L - (B\alpha^2/I)(1 - Z_1^L)s_2\bar{\phi}_2^L}{\alpha A[\alpha Z_1^L + \gamma_1(n_1 - 1)] + (B\alpha^2/I)(1 - Z_1^L)s_1} \tag{21}$$

where $Z_1^L \equiv 1 - \dfrac{d\pi}{dw_{1j}} = 1 - \left[\dfrac{\alpha^2}{(\alpha^2 + I)}\dfrac{s_1}{n_1} + \dfrac{s_2}{n_1}\Theta_2\right], \qquad j = 1, \ldots, n_1. \tag{22}$

It appears that the reaction function for the wage premium in (21) is analogous to the expression obtained under simultaneous wage bargaining

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[27] Note that when $B = 0$ there is no link between the *real* wages of the two countries (see (11)) but *nominal* wages are still linked (see (20)).

[28] This follows from the fact that the *real* wage premia are strategic substitutes (Section 3).

with the crucial difference that Z_1^U is now replaced by Z_1^L.[29] This captures the essential difference between the two scenarios. Under wage leadership, the unions of Country 1 internalise the impact of their wage decisions on inflation to a different extent than under simultaneous bargaining. This happens because they take account of the reaction of Country 2 wages to their own wages.[30] If this reaction is positive (i.e. if $\partial \bar{w}_2 / \partial \bar{w}_1 \equiv \Theta_2 > 0$), then each union in Country 1 perceives a higher impact of its nominal wage choice on inflation, and hence a lower impact on the real wage (a lower Z). The following proposition summarises the effects of wage leadership on the equilibrium real wage as compared to a MU with simultaneous wage bargaining (the proof appears in the appendix):

PROPOSITION 5. *In comparison to a MU in which all unions move simulta-neously, under wage leadership the wage premium of the unions that are leaders is smaller (greater) and that of the followers is greater (smaller) if the unions' inflation aversion is sufficiently small (large), i.e. when $B < B_T$ ($B > B_T$).*

The origin of dependence of results on the size of B is related to Remark 1. We saw there that, if the unions' willingness to maintain their real wage in the face of higher inflation is greater (lesser) than their desire to moderate this inflation, the leading unions respond by raising (lowering) their nominal wages. For instance, when the unions' inflation aversion is sufficiently large ($B > B_T$), the leading unions have more leeway for higher wage demands, since they know that some of the inflationary consequences of their actions will be offset by the decrease in the real wage of the (strongly inflation-averse) follower unions (outcomes under wage leadership and simultaneous bargain-ing coincide in the special case where $B = B_T$). The following observation is useful to understand the area-wide effects of wage leadership (the proof is in the appendix):

REMARK 2. *Under wage leadership the average wage premium in the MU and the average wage premium of the leading unions are positively related.*

An immediate consequence of this and Proposition 5 is:

PROPOSITION 6. *In comparison to a MU in which all unions move simulta-neously, inflation, unemployment and the average level of real wages in the MU are smaller (greater) under wage leadership than under simultaneous bargaining if the unions' inflation aversion is sufficiently small (large), i.e. when $B < B_T$ ($B > B_T$).*

We conclude this subsection with an analysis of how the response of the followers to a change in the nominal wage of the leaders depends on the bargaining structure within the MU. The following observation concerning the

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[29] The reaction function of Country 2 wage premium to Country 1 is unchanged by the assumption of leadership, because the unions of Country 2 (i.e. the followers) take Country 1 wages as given under both scenarios. Hence the reaction of ϕ_2^L to ϕ_1^L is given by (11).

[30] Technically, under simultaneous moves $d\pi/dw_{1j}|_{\bar{w}_2} = \partial\pi/\partial w_{1j}$ while under leadership $d\pi/dw_{1j} = \partial\pi/\partial w_{1j} + (\partial\pi/\partial\bar{w}_2)(\partial\bar{w}_2/\partial\bar{w}_1)(\partial\bar{w}_1/\partial w_{1j})$.

reaction of Country 2 wages to wages in Country 1 provides an intermediate step:

REMARK 3. *The cross-partial derivative $\partial^2 \bar{w}_2/(\partial n_2 \partial \bar{w}_1)$ is positive, i.e. $\partial \bar{w}_2/\partial \bar{w}_1$ is increasing in n_2. If $n_2 \to \infty$ then $\partial \bar{w}_2/\partial \bar{w}_1 = \alpha^2 s_1/(\alpha^2 s_1 + I)$.*

The above implies:

PROPOSITION 7. *As the wage bargaining structure in the 'follower' country becomes more decentralised, the wage premium in the 'leader' country decreases.*

This means that the largest moderating effect on the unions of the leader country occurs if the labour market structure in the 'follower' country is highly decentralised. The reason is that in this case the unions of the leader country cannot rely on the inflation aversion of the followers to offset (in part) the consequences of their inflationary actions. As a result, the unions in the leader country internalise the inflationary consequences of their wage decisions to a larger extent.

6. Normative Implications: A Discussion

The purpose of this section is threefold: first, to flash out a warning about the (inherently pessimistic) normative implications of our analysis. Second to show that the adverse effects of the MU on unemployment and inflation highlighted above cannot be fully offset by the adjustment of monetary institutions alone. Third, to show that the formation of a monetary union alters the adverse real effects of an increase in CB conservatism, making them relatively less painful.[31]

6.1. *Limitations of the Analysis*

This paper showed that, in the absence of additional changes, the establishment of a MU is likely to increase unemployment and inflation. A strict interpretation of the model would thus suggest that the MU is Pareto dominated, in welfare terms, by the NMP regime. Clearly, there are benefits related to the establishment of a the MU which are not captured by our model. For instance, the MU may increase the efficiency of the banking sector and competition in goods and labour markets (an effect we deliberately abstracted from − see Section 1 and footnote 8) or help some countries to reduce the inflation bias of monetary policy (lowering real interest rates and risk premia) or solve a coordination problem that governments may face under national monetary policies.[32] Our choice to use a stylised model without cross-country spillovers, differential credibility problems and/or fiscal imbalances is likely to limit the normative scope of our results (as it happens, sometimes, to economists). In our view, the contribution of the paper is to highlight a novel effect

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[31] We are grateful to Mike Wickens and the referees of this JOURNAL for raising these issues.
[32] Each of these possibilities has been investigated, respectively, by Burda (1999), Giavazzi and Pagano (1988) and Rogoff (1985b).

that is likely to be associated with the formation of a MU, when all other things remain the same.

While the model suggests that this effect reduces welfare, it goes without saying that an overall welfare assessment of the MU should weight this welfare cost against the other (unmodelled) costs and benefits of the MU. But these additional effects may qualify, but not *eliminate,* the adverse effects identified here. Indirect confirmation of this conjecture is that the monetary regime is shown to have real effects also in models where cross-country spillovers exist, provided that the private sector is non-atomistic (e.g. Jensen, 1993; Rama, 1994; Holden, 1999, 2001; Zervoyianni, 1997).

6.2. *Can Central Bank Reform Solve the Adverse Effect of a MU on Unemployment?*

Another normative issue raised by our analysis concerns the following question: is it possible to eliminate the adverse effect of the creation of a MU on unemployment by an appropriate adjustment of central bank conservatism? The answer to this question, within the framework of this paper, is illustrated below in the, commonly treated and simpler, case of identical countries and inflation indifferent unions.

It was shown in Section 4 that the formation of a MU raises the wage premium (Proposition 4), hence raising unemployment across the MU. We now examine whether it is possible to offset this adverse effect by changing the level of CB conservativeness (I). Let $u^U(I) > u^N(I)$ be the equilibrium values of unemployment (under a MU and NMP, respectively) as functions of a given value of I (initially common under both MU and NMP). It appears from (16) that if the establishment of the MU also involves a change in the level of central bank conservativeness, this has an additional effect on the real wage premium. Let I and I^U be, respectively, the levels of central bank conservativeness under NMP and in the MU. Tedious algebra, using (14) and (16), for $B = 0$, reveals that $\partial \pi^U / \partial I^U < 0$ and $\partial u^U / \partial I^U > 0$ provided $1 < n < \infty$. Therefore, an increase in the level of central bank conservativeness involves a benefit (lower inflation) and a cost (higher unemployment). Equation (16) can be used to derive that level of conservativeness, $I^U < I$, that makes unemployment in the MU equal to its equilibrium level under NMP.[33] But such a change also involves an increase in inflation which is larger than the one that occurs when $I^U = I$ (i.e. $\pi^U(\underline{I}^U) > \pi^U(I)$). Therefore, changing the level of central bank conservativeness solves one problem at the expense of the other. Whether or not this is welfare improving in comparison to a MU where central bank conservatism is unchanged ($I^U = I$) depends on society's preferences for inflation versus unemployment.

The upshot is that no matter what the preferred reform of the central bank is (whether towards more conservatism or liberalism), such a reform alone

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[33] Solving $u^U(\underline{I}^U) = u^N(I)$ yields $\underline{I}^U = (I - \alpha^2)/2$ which is a feasible level of conservatism if $I > \alpha^2$.

cannot fully resolve the adverse repercussions, for unemployment without raising inflation.[34]

6.3. *Do the Effects of Conservatism Change in a Monetary Union?*

Since it reduces the deterrence of the adverse competition effect and of unions' inflationary fears, a higher degree of conservatism raises unemployment. We show here that in a monetary union an increase in conservativeness raises unemployment by less than under NMP. This suggests that the adoption of a strong anti-inflation stance is less costly (in terms of unemployment) for the single central bank of the area than it is for a national central bank before the MU. This conclusion is reinforced further by the fact (demonstrated below) that, by reducing this adverse effect, conservatism also becomes more effective in controlling inflation.

   We turn now to a more precise characterisation and demonstration of those claims for the case of identical countries. In this case the wage premium is given by (16). The adverse effect of conservatism on the wage premium (and through (14) also on unemployment) is captured by the partial derivative of (16) with respect to I

$$\frac{d\phi}{dI} = \frac{\left[\alpha A\gamma(n-1) + \dfrac{B\alpha^2}{I}\right]\dfrac{dZ}{dI} + \dfrac{B\alpha^2}{I}Z(1-Z)}{\left\{\alpha A\gamma(n-1) + \alpha^2\left[\dfrac{B}{I} + \left(A - \dfrac{B}{I}\right)Z\right]\right\}^2} > 0 \qquad (23)$$

where

$$Z \equiv 1 - \frac{\alpha^2}{(\alpha^2 + I)}\frac{s}{n}$$

and $s = 1$ or $s < 1$ depending on whether monetary policy institutions are characterised as NMP or as a MU. An increase in conservativeness raises the wage premium, under both regimes, for all $n < \infty$. To study the impact of a monetary union on this adverse effect we analyse how expression (23) varies with s, i.e. with the reduction of each country's size (relative to the monetary area). Some algebra reveals that the adverse effect is smaller in the monetary union, i.e. $d^2\phi/(dI\,ds) > 0$ (for $1 < n < \infty$) provided the sufficient condition $I > B/A$ holds.[35] This condition, which posits that the central bank is more inflation averse than the typical union, is intuitive and is likely to be satisfied in practice (it is obviously true in the case of inflation indifferent unions).

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[34] But in the presence of unions and monopolistically competitive firms an increase in CB conservativeness can fully eliminate the adverse consequences of the increase in unions' wage aggressiveness. An elaboration appears in footnote 38 in the conclusion.
   In the context of our model, the best institutional measure to be taken would be a decentralisation of the labour market, both under NMP and the MU, as that would eliminate the unions' monopoly power, reducing both unemployment and inflation.
[35] The proof is established by demonstrating that the numerator (denominator) of (23) is increasing (decreasing) in s when $I > B/A$.

This result implies that the adverse effect of an increase in CB conservativeness on unemployment is weaker under a MU than under NMP. Intuitively this is due to the fact that, under a MU, each single labour union is a relatively smaller unit of a broader monetary area. As a consequence the adverse impact of an increase in conservativeness on unions' wage aggressiveness is reduced. Thus, although an increase in CB conservativeness raises the premium both in the MU and under NMP, it raises it by less in the MU.

A related implication of the preceding discussion is that increases in conservatism become relatively more efficient in controlling inflation under a MU. This can be seen by noting (from (9) and (14)) that, for both monetary regimes, $d\pi/dI = (\alpha^2/I)(d\phi/dI - \phi/I)$. The total effect of an increase in I on inflation is given by an indirect inflation-increasing effect (related to the increase in the premium associated with a greater I) and by a direct inflation-decreasing effect (due to the fact that for any given wage premium higher conservatism reduces inflation). The indirect effect reduces the effectiveness of conservatism in reducing inflation. Since the MU reduces the adverse impact of conservatism on the premium ($d\phi/dI$), it thereby raises its relative effectiveness in controlling inflation.[36] In addition, since for the same I the premium is larger under a MU than under NMP, the direct inflation reducing effect of increased conservativeness is larger.

The upshot is that, in a MU, raising I is a relatively more efficient step since it reduces inflation to a greater extent and raises unemployment by less in comparison to NMP.

7. Concluding Remarks

This paper presented a strategic analysis of how the establishment of a monetary union (MU) is likely to alter wage setting behaviour under alternative institutional scenarios and through it macroeconomic performance. The paper highlighted the effects of the formation of a MU that operate via the change in unions' incentives for wage moderation, abstracting from other changes that might be associated with the establishment of a MU, such as changes in the degree of central bank (CB) conservativeness or in the degree of labour market competition. The virtue of this simple approach is to show that, in the presence of sufficiently large unions (i.e. non-atomistic), several neutrality results that would be expected on the basis of traditional analysis no longer hold.

The main lesson of the paper is that the change in the strategic interaction between unions and the CB induced by the formation of a MU leads to changes in equilibrium values of real variables. This occurs only when unions are non-atomistic and partly internalise, therefore, the repercussions of their own actions on other agents' decisions (the CB and other unions). It is

[36] A sufficiently low value of B ensures that the direct effect always dominates and hence that $d\pi/dI < 0$ (see Cukierman and Lippi, 1999). The substance of our argument is unaltered in case this condition is not satisfied (in that case the increase in inflation caused by a greater I is smaller in the MU).

noteworthy that the formation of a MU induces changes in real wages, unemployment and inflation even when all parameters of the involved econo- mies (CB and unions' preferences, number of unions and labour market competitiveness) remain unchanged by the MU.

A basic mechanism driving those results is that the formation of a MU unambiguously reduces each union's perception of how inflationary its indivi- dual actions are. This happens because in the MU each union is relatively smaller compared with the pre-MU situation. When a typical union is con- cerned about inflation, this reduced inflationary perception leads the union to demand a higher wage premium, increasing unemployment and inflation. A similar effect of the MU is presented in Grüner and Hefeker (1999). However, since in their model there is a single monopoly union in each country, the real effects of the MU hinge on the assumption that unions are inflation averse. Our analysis generalises their result by demonstrating that in a multi-union context the establishment of a MU has real repercussions even when unions are *not* averse to inflation. This second type of non-neutrality is due to the fact that, when wages are bargained in nominal terms, the degree of conservative- ness of the central bank affects each union's perception of how costly it is, in terms of reduced competitiveness, to increase its individual wage.[37]

As mentioned, a central proposition of the paper is that the MU may lead to more aggressive wage behaviour, and hence increase unemployment in the participating countries, provided unions are non-atomistic. The paper shows that, in general, the magnitude of this real effect of the MU depends on structural features of the economy. Smaller countries are likely to show the largest effects since their (non-atomistic) unions are the ones which experi- ence the largest relative-size change. Moreover, it is shown that the adverse employment effect is greatest at intermediate levels of centralisation and of labour market competitiveness, since in this range unions' behaviour is more opportunistic because neither a 'competition-effect' nor an 'internalisation- effect' moderate their wage demands.

The robustness of the results under two alternative institutional scenarios, which may be relevant in Europe, are further examined. The first scenario recognizes that several European countries were already committed to German monetary policy, prior to joining the MU, through the Exchange rate mechan- ism (ERM). Under the assumption that this commitment was credible, the analysis predicts that with the adoption of the MU the unemployment problem may become more serious in Germany (the pre MU anchor country) and less serious in the satellite countries. In the second scenario we study how wage- leadership by the unions of one country alters macro performance in the MU compared with a case in which all unions in the MU move simultaneously. The analysis suggests that if unions' inflation aversion is not 'too high', the MU average wage premium, as well as that of the unions in the 'leader' country,

are lower than the corresponding premia in a MU with simultaneous bargaining. Moreover, the moderating effect on average wage demands in the MU, as well as on the wages of unions in the 'leader' country, are larger when the labour market structure in the 'follower' country is highly decentralised.

Since the adverse effects, on employment and inflation, studied in this paper are generated by a monetary reform, we investigate whether they can be neutralised by adjusting the level of central bank conservativeness along with the establishment of the MU. Unfortunately this turns out not to be the case because, in our framework, the choice of CB conservativeness induces a long run tradeoff between inflation and unemployment.[38] But, at least for the case of identical countries this tradeoff is more favourable to higher CB conservativeness (or stricter inflation targeting) in the case of a MU. An overall welfare assessment of the MU should weight the adverse effects discussed in this paper against other costs and benefits of the MU, that are not considered here. But this is beyond the scope of this paper

Our model can be used in principle to analyse how the MU affects policymakers' incentives to reform the labour market. This issue is relevant for Europe, where labour market rigidities are considered by many as an important determinant of poor employment performance (Bean, 1994; Nickell, 1997). Calmfors (1998b; 2000) has argued that the creation of EMU may stimulate reforms in labour market institutions. Sibert and Sutherland (2000) have recently used a variant of the Barro-Gordon model to analyse this question. In their model monetary policy is discretionary and policymakers face an inflationary bias that is directly proportional to the rate of unemployment. Moreover, owing to international spillovers, inflation is higher when monetary policy is implemented in an uncoordinated manner (i.e. NMP) than in the MU. Policymakers have an incentive to reduce labour market distortions, because this lowers the equilibrium rate of unemployment and hence of inflation. A main point of their paper is that, since inflation in the MU is lower than under NMP, the incentives to eliminate labour market distortions are lower in the MU than under NMP.

This result hinges on the assumption that the formation of a MU does not have a direct effect on the unemployment rate. In this paper we showed that, even in the absence of other changes, the formation of a MU usually raises unemployment. In light of the Sibert and Sutherland's main result this should increase policymakers' incentives for reform. This mitigates the lower incentives for reform identified by the above-mentioned authors. But a thorough investigation of this issue is beyond the scope of this paper

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[38] But this pessimistic result disappears in the presence of monopolistically competitive, price setting firms. In such a framework an increase in CB conservativeness usually reduces *both* inflation and unemployment (Coricelli *et al.* (2000)).This difference in results is due to the fact that in our paper an increase in CB conservativeness reduces the deterring influence of the adverse competitive effect. By contrast in Coricelli *et al.* (2000), since deterrance operates via the unemployment fears of unions, an increase in CB conservativeness reduces (rather than increases) the wage premium, and with it both inflation and unemployment.

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A. Appendix: Proofs

Proof of Proposition 4. The direct effect of the MU in country i when unions do not care about price stability is given by the difference $\bar{\phi}_i^U - \bar{\phi}_i^N$, under the condition $B = 0$. Using (18) and (7) (both with $B = 0$), to write this difference we obtain

$$\chi_i \equiv \bar{\phi}_i^U - \bar{\phi}_i^N = \frac{\gamma_i(n_i - 1)(Z_i^U - Z_i^N)}{\alpha A[\gamma_i(n_i - 1) + \alpha Z_i^U][\gamma_i(n_i - 1) + \alpha Z_i^N]}, \qquad i = 1, 2. \quad (A.1)$$

(where $Z_i^U = 1 - \theta s_i/n_i$; $Z_i^N = 1 - \theta/n_i$; $\theta \equiv \alpha^2/(\alpha^2 + I)$. It appears that the difference χ_i is positive for all $n > 1$ and $\gamma > 0$. This establishes part (i).

Part (ii): This follows immediately from the sign of the partial derivative $\partial \chi_i/\partial s_i$, which is smaller than zero over the entire relevant domain of parameters.

Part (iii): The partial derivatives $\partial \chi_i/\partial n_i$ and $\partial \chi_i/\partial \gamma_i$ are given by:

$$\frac{\partial \chi_i}{\partial n_i} = \frac{\gamma_i(Z^U - Z^N)}{\alpha AD^2} T \quad (A.2)$$

and

$$\frac{\partial \chi_i}{\partial \gamma_i} = \frac{(n - 1)(Z^U - Z^N)}{\alpha AD^2}\left[\alpha^2 Z^U Z^N - \gamma^2(n - 1)^2\right] \quad (A.3)$$

where

$$T \equiv \left(\frac{D}{n} - (n - 1)\left\{2\gamma(n - 1)\left(\gamma + \frac{\alpha\theta}{n^2}\right) + \gamma\alpha\left[2 - \frac{\theta(1 + s_i)}{n}\right] + \frac{\alpha^2\theta}{n^2}\left(1 + s_i - 2\frac{\theta s_i}{n}\right)\right\}\right)$$

and D is the product of the terms in the square brackets in the denominator of (A.1). Algebraic analysis of (A.2) (and of (A.3)) reveals that both expressions are: continuous in $n(\gamma)$ for $n > 1$ ($\gamma > 0$), larger than zero at $n = 1$ ($\gamma = 0$), negative for a sufficiently large $n(\gamma)$ and converging towards zero from below as $n \to \infty$ ($\gamma \to \infty$). Since both expressions switch from a positive to a negative sign only once as n and γ increase, it follows that the difference χ_i has a unique global maximum at intermediate values of n and of γ. This proves part (iii).   ∎

Proof of Proposition 5. The reaction function of Country 2's average wage premium to Country 1's average wage premium is given by (11) and is unaffected by whether wage bargaining is characterised by simultaneous moves or by wage leadership. The reaction of Country 1's average wage premium to Country 2's average premium is given by (21). When $B = B_T$, $Z_1^L = Z_1^U$ so that Country 1's reaction function under leadership is identical to its reaction function under simultaneous bargaining. Hence, when $B = B_T$ the equilibrium wage premia under leadership and under simultaneous bargaining are identical. This establishes part (iii) of the proposition.

More generally, when $B \neq B_T$, the only difference from the preceding case is that the value of Z_1 in the reaction function of the leaders is Z_1^L rather than Z_1^U. It follows

that the equilibrium average wage premium of the group of leading unions is still given by (13) with Z_1^U replaced by Z_1^L. Replacing either of these by any value of Z_1, yields:

$$\bar{\phi}_1 = \frac{Z_1 H_2^U + (B\alpha^2/I)(Z_1 - Z_2^U)s_2}{H_1\left[H_2^U + (B\alpha^2/I)(1 - Z_2^U)s_2\right] + (B\alpha^2/I)(1 - Z_1)H_2^U s_1} \tag{A.4}$$

where $H_1 \equiv \alpha A[\alpha Z_1 + \gamma_1(n_1 - 1)]$ for any value of Z_1. Differentiating (A.4) with respect to Z_1 and rearranging

$$\frac{\partial \bar{\phi}_1}{\partial Z_1} = \frac{1}{M^2}\left\{\left[H_2^U + \frac{B\alpha^2}{I}\left(1 - Z_2^U\right)s_2\right]M_1 + \frac{B\alpha^2}{I}H_2^U s_1 M_2\right\} \tag{A.5}$$

where

$$M_1 \equiv \alpha A\left\{\gamma_1(n_1 - 1)H_2^U + \frac{B\alpha^2}{I}s_2\left[\gamma_1(n_1 - 1) + \alpha Z_2^U\right]\right\} > 0$$

$$M_2 \equiv H_2^U + \frac{B\alpha^2}{I}s_2(1 - Z_2^U) > 0$$

and M is the denominator of the expression in (A.4). Since Z_2^U and Z_1 are bounded between zero and one, and since $n_1 \geqslant 1$, the expression in (A.5) is positive so that the average wage premium of the leading unions is a monotonically increasing function of Z_1. The proof of parts (i) and (ii) for the unions of Country 1 follows by noting, from Remark 1, that Z_1^L is smaller or larger than Z_1^U depending on whether Θ_2 is positive or negative, which depends in turn on whether B is smaller or larger than B_T. The proof of parts (i) and (ii) for the average premium of the unions in Country 2 follows by recalling, from (11), that the two wage premia are strategic substitutes.   ∎

Proof of Remark 2. The average wage premium in the MU under the wage leadership of unions in Country 1 is:

$$\bar{\phi}^L = s_1\bar{\phi}_1^L + s_2\bar{\phi}_2^L = s_1\bar{\phi}_1^L + s_2\frac{Z_2^U - (B\alpha^2/I)(1 - Z_2^U)s_1\bar{\phi}_1^L}{H_2^U + (B\alpha^2/I)(1 - Z_2^U)s_2} \tag{A.6}$$

where $\bar{\phi}^L$, $\bar{\phi}_1^L$ and $\bar{\phi}_2^L$ are respectively the area wide average wage premium and the average wage premia in countries 1 and 2 when the unions of Country 1 are wage leaders. The second equality follows from (11) and from the fact that the reaction function of Country 2's unions is the same under simultaneous bargaining and under wage leadership by the unions of Country 1. Differentiating (A.6) with respect to $\bar{\phi}_1^L$ and rearranging

$$\frac{\partial \bar{\phi}^L}{\partial \bar{\phi}_1^L} = \frac{s_1 H_2^U}{H_2^U + (B\alpha^2/I)(1 - Z_2^U)s_2} \tag{A.7}$$

which is unambiguously positive establishing that $\bar{\phi}^L$ and $\bar{\phi}_1^L$ are positively related.   ∎

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